# MONITORING RESIDUES OF DDVP IN ROOM AIR AND ON HORIZONTAL SURFACES FOLLOWING USE OF A ROOM FOGGER

by

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## SUMMARY

The air levels of DDVP (2,2-dichlorovinyl 0,0-dimethylphosphate; dichlorovos) in a room of a residence were monitored during and after the release of this pesticide from a pressurized home fogger container. The study was undertaken in order to determine if the 30-minute aeration period prescribed on the label was sufficient to allow safe reentry into a home or room. The air levels were below the recommended industrial workplace permissible exposure level (PEL) of 1 $mg/m^3$ at the end of the aeration period; however, the DDVP dissipated quite slowly after that. There is concern that maximum exposure levels for infants, the elderly, and those who are ill, as well as healthy adults occupying rooms almost 24 hours per day, should be well below the PEL considered acceptable for the workplace. Assuming a more acceptable level for the home is 1/40 of the PEL, rooms treated with this type of application device should not be reentered for 10 hours, if outdoor windows or doors can be opened to assist in ventilation. The product should not be used if the only ventilation possible is the dissipation of residues into other rooms of the house or apartment. When outside windows and doors were not opened but the door to the remainder of the house was opened, it took 18 hours for the treated room levels to reach 1/40 of the TVL. Residues of DDVP on horizontal surfaces were studied for 7 hours; more studies of these residues are needed.

## INTRODUCTION

Over the past several years, concern has developed over the possible health hazards following the use of home foggers which were designed to release insecticides into the room of a house. These products seem to be highly effective in ridding a room of many insects. This efficacy is due to saturating the air of a room with an aerosol containing one or more pesticides.

DDVP is used in many of these home fogger products. This insecticide is an organophosphate and is very toxic with an acute oral $LD_{50}$ (rat) of 56-80 mg/kg and an acute dermal $LD_{50}$ of 107 mg/kg. However, these home use products usually contain approximately 0.5% of the active ingredient (DDVP). There have been a number of reports to poison centers in California concerning exposures and illnesses related to the release of these home foggers. DDVP seems to be the active ingredient most often associated with these reported exposures. This study was conducted as a range-finding study to determine the air levels of DDVP and the dissipation rate from a horizontal surface both during and after the release of a home fogger.

## MATERIALS AND METHODS

A 6-oz. can of a widely used fogger which contains 0.5% of DDVP was used in this study. Air samples were collected by drawing air through an XAD-4 sampling tube using an MSA Model G or S personnel air pump. The air pumps ran for 1 hour at the rate of 1 liter/minute. During the 2-hour treatment period and the 30-minute aeration period, pumps were started every 20 minutes. After the aeration period pumps were started at 1, 2, 4, 8, 24, 36, 48 and 72 hours post-aeration. Wipe samples were collected immediately following the 30-minute aeration period and at 1, 2, 4, 8, 24, 36 and 48 hours post-aeration. The wipe samples were collected according to the OSHA method for purposes of establishing a violation of 29 CFR 1910-132 (a).

The entire contents of a fogger were dispensed into a room; two different rooms were used in the study. One room measured 11.42'x13'x8' (1187.7 cubic feet); the other measured 10.58'x13.67'x8' (1157 cubic feet). One room was used for two trials with the trials being 6 weeks apart. Each can was completely dispensed into a closed room. The treated room remained closed for the recommended 2-hour treatment time then was allowed to air out. The aeriation was accomplished in one or two ways: 1) opening a window or door to the outside air or 2) opening the door into the rest of the house (not allowing ventilation directly from the outside air).

The methods of analysis are given in the appendix.

## RESULTS

As shown in Table 1 and Figure 1, the air levels are generally below the workplace PEL of 1 $mg/m^3$ by the end of the 2-hour treatment period. By the end of the 30-minute aeriation period, the levels of DDVP ranged from 0.22 $mg/m^3$ to 0.75 $mg/m^3$.

## DISCUSSION

As a guide for appropriate air levels for reentry into a treated room, we have been using the permissible exposure levels (PELs) accepted by OSHA. The PEL is set as a maximum air level allowable for a person working 7 hours a day, five days a week. An adult living at home full-time might be exposed to more than 4 times this number of hours in a week. Thus, a healthy adult should not be exposed to more than 1/4 the workplace PEL. The aeration period required to reach 1/4 the PEL ranged from 1/2 hour when the door to the treated room was open only to the rest of the house to approximately 3 hours when only a window could be opened to allow outside ventilation.

An infant, elderly person or a person who is ill might be more susceptible to the effects of this chemical. An additional 10-fold safety factor should be provided to address the increased hazard. Thus, we used 1/40 the workplace PEL as a guide for reentry into the treated room. This study suggests that it would take an aeration period ranging from about 10 hours when a door from the treated area could be open to the outside to as long as 18 hours when the door to the treated room can only be open to the rest of the house. This study suggest that a longer ventilation period may be required, depending on the method of aeriation. Residues on horizontal surfaces of DDVP were studied for 7 hours; these studies need to be extended.

This study led to a detailed evaluation of the use instructions of a number of room fogger products currently registered for use by the U. S. Environmental Protection Agency and also by the California Department of Food and Agriculture.

The following are some of the problems noted with the use instructions of some of these home foggers that contain DDVP. Concerns are being raised as to the adequate mitigation of hazards to users and the data upon which such instructions are based.

1. They do not inform the user or physician that the product contains a cholinesterase inhibitor.

2. They do not inform the physician that atropine is antidotal.

3. They do not inform the user of the symptoms of organophosphate or N-methyl carbamate poisoning.

4. They do not have adequate first-aid statements for eye and skin exposure.

5. Any data submitted and the use instructions do not deal with the special susceptibility of infants, persons who are ill or the elderly.

6. They do not prohibit indoor use if a window or outside door cannot be opened to allow for adequate ventilation of the room after treatment.

7. They do not specify reentry period.

8. They do specify a specific reentry period but do not provide supportive indoor exposure data.

9. They do not inform the user to vacate the treatment area.

10. They inform user to vacate treatment area, but do not specify the length of time.

11. They do not inform the user to ventilate the treated area.

12. They do inform user to ventilate the treated area, but do not specify how to ventilate or the length of time for ventilation.

13. Use instructions do not explicitly explain how to avoid exposure while setting the device for release.

14. The can contains very explosive materials, such as propane and butane, and fails to disclose them to the user by keeping them grouped under undisclosed "inert" ingredients.

15. The can contains explosive materials with no mention of avoiding open flames.

16. The can contains highly toxic "inert" ingredients which are not disclosed to the user.

17. The can contains an "inert" ingredient which is a suspected carcinogen.

18. The Registration request was not supported by indoor exposure data giving levels of active and "inert" ingredients in the air and on the tops of horizontal surfaces at various intervals after application in rooms of specified size, and with specific information as to the treatment time with doors closed, and ventilation time with outside windows and outside doors open.

This evaluation suggests that further studies are needed and that new criteria for registration are needed, as well as a reevaluation of the current registrations.

TABLE 1

Air Levels of DDVP Resulting From the Use of a Home Fogger

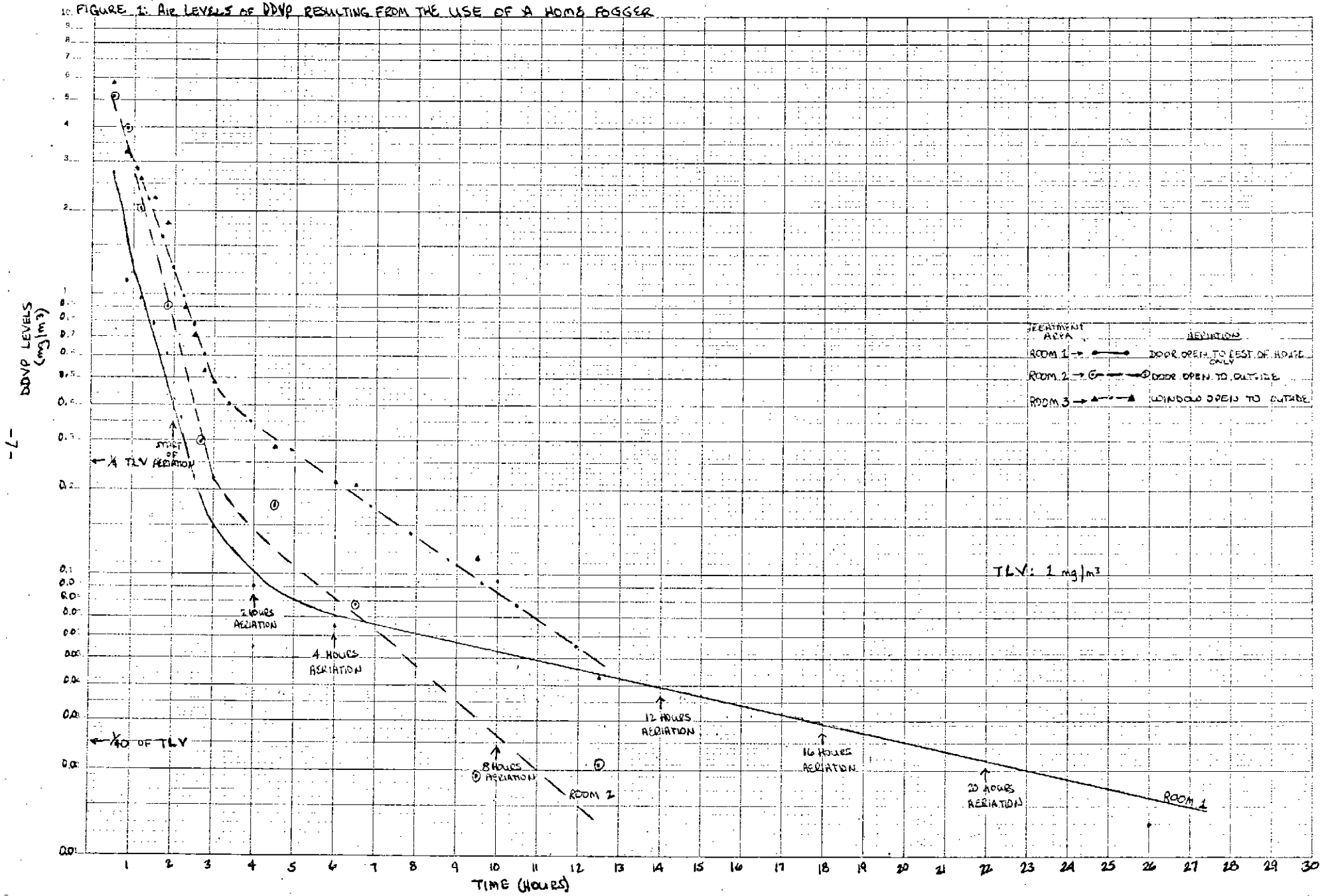
| Sample Source | Date | Time On | Sample Time (Min) | Average Time From Start of Treatment | Results PPB | Results $mg/m^3$ |
|---|---|---|---|---|---|---|
| Room 1 | 6/3/81 | 0710 | 60 | 30 min. | 309.1 | 2.781 |
| | | 0130 | 60 | 50 min. | 124.9 | 1.124 |
| | | 0750 | 60 | 1 hr. 10 min. | 108.2 | 0.973 |
| | | 0810 | 60 | 1.hr. 30 min. | 86.8 | 0.781 |
| | | 0830 | 60 | 1 hr. 50 min. | 67.7 | 0.609 |
| | | 0850 | 60 | 2 hr. 10 min. | 40.2 | 0.361 |
| | | 0910 | 60 | 2 hr. 30 min. | 24.8 | 0.223 |
| | | 0940 | 60 | 3 hr. | 16.6 | 0.149 |
| | | 1040 | 60 | 4 hr. | 10.1 | 0.091 |
| | | 1240 | 60 | 6 hr. | 7.22 | 0.065 |
| | | 1640 | 60 | 10 hr. | 10.53 | 0.095 |
| | 6/4/81 | 0840 | 60 | 24 hr. | 1.43 | 0.013 |
| | | 2200 | 60 | 37 hr. 50 min. | 1.51 | 0.014 |
| | 6/5/81 | 0840 | 60 | 48 hr. | 1.07 | 0.010 |
| | 6/6/81 | 0840 | 60 | 72 hr. | ND | ND * |
| Room 2 | 4/26/81 | 1230 | 60 | 30 min. | 565.9 | 5.185 |
| | | 1250 | 60 | 50 min. | 431.1 | 3.95 |
| | | 1310 | 60 | 1 hr. 10 min. | 223.0 | 2.04 |
| | | 1350 | 60 | 1 hr. 50 min. | 99.9 | 0.916 |
| | | 1440 | 60 | 2 hr. 40 min. | 32.5 | 0.298 |
| | | 1500 | 60 | 3 hr. | 24.1 | 0.221 |
| | | 1630 | 60 | 4 hr. 30 min. | 19.3 | 0.177 |
| | | 1830 | 65 | 6 hr. 32 min. | 8.37 | 0.077 |
| | | 2130 | 60 | 9 hr. 30 min. | 2.05 | 0.019 |
| | | 2430 | 57 | 12 hr. 28 min. | 2.24 | 0.021 |
| Room 3 | 4/26/81 | 1230 | 60 | 30 min. | 624.7 | 5.72 |
| | | 1250 | 60 | 50 min. | 356.0 | 3.26 |
| | | 1310 | 60 | 1 hr. 10 min. | 284.0 | 2.61 |
| | | 1330 | 60 | 1 hr. 30 min. | 241.5 | 2.21 |
| | | 1350 | 60 | 1 hr. 50 min. | 195.9 | 1.80 |
| | | 1414 | 60 | 2 hr. 14 min. | 97.8 | 0.896 |
| | | 1432 | 60 | 2 hr. 32 min. | 77.4 | 0.709 |
| | | 1445 | 60 | 2 hr. 45 min. | 58.2 | 0.533 |
| | | 1500 | 60 | 3 hr. | 52.7 | 0.483 |
| | | 1630 | 60 | 4 hr. 30 min. | 30.9 | 0.283 |
| | | 1830 | 65 | 6 hr. 30 min. | 22.7 | 0.208 |
| | | 2130 | 60 | 9 hr. 30 min | 12.5 | 0.114 |
| | | 2430 | 57 | 12 hr. 28 min. | 5.75 | 0.053 |

TABLE II

Wipe Samples Collected Following the Treatment and Aeriation Period of the Use of a Home Fogger Containing DDVP

| Sample Source | Date | Aeriation Period (Hours) | Results ($mg/100\ cm^2$) |
|---|---|---|---|
| Room 2 | 4/26/81 | Presample | ND |
| | | 1/2 | 0.8 |
| | | 2 | 0.79 |
| | | 4 | 0.39 |
| | | 7 | 0.54 |
| Room 3 | 4/26/81 | Presample | ND |
| | | 1/2 | 0.36 |
| | | 2 | 0.25 |
| | | 4 | 0.21 |
| | | 7 | 0.42 |

FIGURE 1: AIR LEVELS OF DDVP RESULTING FROM THE USE OF A HOME FOGGER



## APPENDIX

## Analytical Procedures

### Air Samples

1. Score air sample tubes in front of the first section of adsorbent with a file, and break open. Remove and discard the glass wool.

2. Transfer the adsorbent in the upstream section to a labeled desorption vial, and add 2 ml ethyl acetate.

3. Remove and discard the foam partition, and transfer the second section of adsorbent to a labeled desorption vial, and add 2 ml ethyl acetate.

4. Allow samples to desorb for 1 hour on the rotator.

5. Determine DDVP by GLC.

6. Determine the desorption efficiency by injecting a known amount of DDVP into a number of air sample tubes (with the second section and foam plug removed) and cap the tubes with supplied caps. Prepare one tube in a like manner, but with no DDVP to use as a blank sample. Allow to stand overnight and analyze by the analytical protocol.
   Desorption efficiency = $\frac{\text{Response sample - response blank}}{\text{Response standard.}}$

### Air Sample Calculations

1. Determine the weight of DDVP present on the air sample tube sections by GLC. Nanograms or micrograms are most convenient.

2. Correct this total weight by subtacting the weight of DDVP present on the blank tube.

3. The corrected weight is divided by the desorption efficiency to obtain the final weight of DDVP present.

4. The volume of air sampled is converted to standard conditions of 25° C and 760 mm Hg.

$$VS = V \times \frac{P \times 298}{760 \times (T + 273)}$$

Where: VS = Volume of air at standard conditions.
V = Volume of air as measured.
P = Barometric pressure in mm Hg.
T = Temperature of air in °C.

5. Calculate ppb in air from above data.

$$\text{ppb (V/V)} = \frac{\text{ng} \times 24.45}{\text{VS} \times 221.0}$$

24.45 is the molar volume of DDVP at standard conditions.
221.0 is the molecular weight of DDVP.

SWAB SAMPLES

1. Add 50 ml ethyl acetate to the jar containing the swabs, cap with aluminum foil and the screw cap.

2. Desorb the samples on the rotator for 2 hours.

3. Analyze directly by GLC. Report results as total micrograms per sample.

Gas Chromatographic Conditions for DDVP

The gas chromatograph used was a Varian 3700 operated under the following conditions:

Column: 6' x 2 mm i.d. glass with 10% SP 2100 on 100/120 Chromabsorb WHP @ 130°C.

Carrier gas: 20 ml/min $N_2$

Detector: Phosphorus - specific temperature - controlled bead. Set conditions according to manufacturer's suggestions.